(51) International Patent Classification [5] :		(11) International Publication Number:	**WO 91/08555**
G07C 9/00, G06K 9/20	**A1**	(43) International Publication Date:	13 June 1991 (13.06.91)

(54) Title: IMPROVEMENTS RELATING TO VERIFICATION OR AUTHENTICATION PROCESSES

(57) Abstract

A method of updating reference biometric data characteristic of an individual for use in a verification or authentication process in which process the relationship between the currently measured biometric data and the reference biometric data is determined. The method comprises monitoring the acceptability of the relationship determined during a number of verification of authentication processes; and if a number N (e.g. 3) of the relationships over a number M (e.g. 8) of verification or authentication processes is unacceptable, updating the reference biometric data with more recently obtained biometric data.

IMPROVEMENTS RELATING TO VERIFICATION
OR AUTHENTICATION PROCESSES

The invention relates to a method of updating
5   reference biometric data characteristic of an individual
for use in a verification or authentication process in
which process the relationship between currently measured
biometric data and the reference biometric data is
determined.

10   It is becoming common to make use of biometric data to
verify or authenticate an individual prior to permitting
that individual to take part in a transfer of value
transaction, gain access to a building and the like.
Biometric data defines one or more physical or behavioural
15   characteristics of the individual and includes signature,
voice and fingerprint data and the like. In a conventional
verification or authentication process, an individual is
initially enrolled during which reference biometric data is
obtained (possibly by averaging a number of samples) and
20   then during subsequent verification or authentication
processes, this reference data is compared with currently
measured biometric data. For example, a value may be
generated defining the difference between two sets of data
and this value is then compared with a threshold. If the
25   value is greater than the threshold then the individual is
not verified or authenticated but otherwise authentication
is achieved.

One of the problems with the conventional system is
the manner in which initial enrolment is performed.
30   Generally, a number of sets of biometric data have to be
supplied which are then processed to form a final reference
data set.

Furthermore it has been the practice in a number of
identification systems to continually update the reference
35   biometric data whenever a successful identification occurs.
Thus, as soon as an individual passes the required
verification or authentication requirements, the reference

SUBSTITUTE SHEET

2

biometric data is replaced by the currently measured
biometric data.

In accordance with the present invention, a method of
updating reference biometric data characteristic of an
individual for use in a verification or authentication
process in which process the relationship between the
currently measured biometric data and the reference
biometric data is determined comprises monitoring the
acceptibility of the relationship determined during a
number of verification or authentication processes; and if
a number N of the relationships over a number M of
verification or authentication processes is unacceptable,
updating the reference biometric data with more recently
obtained biometric data.

We have devised a method which allows a very simple
enrolment process, generally the supply of a single set of
biometric data, but which updates that reference data
depending upon the performance of the individual during
subsequent verification or authentication processes. It
should be noted, in contrast, that previous updating
techniques have not monitored the performance of the user
but have simply replaced the reference data on every
occasion of a successful identification. Our method also
reduces the need for formal reenrolment in the case of poor
performance.

A problem with biometric characteristics is that these
can vary due to damage, variations in temperature and
variations in the manner in which the parameter is
presented by the individual. Consequently, verification or
authentication processes generally define a tolerance band
within which a current biometric measure must fall. This
tolerance band is defined by the initial reference data.
A balance has to be drawn, however, between making

the band too narrow so as to produce a number of false
acceptances and making the band broad enough to reduce the
number of false rejections. This balance can vary
depending upon the sensitivity of the activity to which the
5   individual is to be permitted access.

A problem with these conventional updating methods is
that where currently measured or bid biometric data fall
close to the limit of a tolerance band then this will be
used to update the reference biometric data thus running
10   the risk that the quality of this reference data will be
degraded by being over written by marginal bid data.

Preferably therefore in order to overcome this
problem, the more recently obtained biometric data which is
used to update the reference biometric data is selected
15   from biometric data which satisfies predetermined
conditions defining a better degree of acceptability than
is essential to pass the verification or authentication
process.

For example, where the relationship used in the
20   verification or authentication process is a tolerance band
within which the currently meausured biometric data must
fall, the predetermined conditions may define a narrower
tolerance band.

In other examples, in which a comparison score is
25   generated defining the relationship between the currently
measured and reference biometric data, only currently
measured biometric data which has a score exceeding a
threshold is used to update the reference biometric data.

In further examples, the condition of the currently
30   measured biometric data is monitored, the predetermined
conditions defining a condition of the currently measured
biometric data exceeding a threshold. For example, in the
case of fingerprint verification, an image of the
fingerprint is formed by contact between the finger and a

4

platen.   The platen is typically made of a polymer material to improve the optical contact of the skin.   The brightness of the image is caused by a good (high area) optical contact.   In this system - contact causes

5   brightness.   Poor contact may occur due to

    1)   Insufficient application pressure.

    2)   Dry skin.

The optical sensor in the unit (CCD imager) recognises the brightness as a voltage output.   This output is

10   digitised and filtered to produce a digital image.

If the brightness is low - the image becomes degraded and starts to be affected by noise - eg. background illumination effects which are always present in the system.

15   On a wider view - ie. applying re-enrolment to other non-optical biometric systems - brightness is synonymous with any sensor output - eg. sound, temperature.

Typically, the most recently obtained measured biometric data which satisfies the predetermined conditions

20   will be used to update the reference biometric data.

In the preferred example, N is at least 3 and M is 8.

In some cases, the user's performance can be so poor that automatic updating of the reference data is insufficient to significantly improve his performance.

25   Preferably therefore the method further comprises monitoring the performance of the user and providing an indication that reenrolment is advisable if the performance of the updating method satisfies predetermined conditions. These predetermined conditions may comprise the

30   detection of at least P consecutive unacceptable relationships, or the performance of at least Q updating steps within R performances of the verification or authentication process.

In the preferred examples, P is 4, Q is 3 and R is 32.

35

An example of a fingerprint verification process incorporating a method according to the invention will now

SUBSTITUTE SHEET

5

be described with reference to the accompaning drawing
which is a flow diagram of the method.

In this description it will be assumed that a
conventional fingerprint detection apparatus is used for
5   example of the type described in PCT/GB90·/01270 the
disclosure of which is incorporated herein by reference.
It should be noted, however, that the present invention is
applicable to all forms of biometric verification including
signature, voice and the like.

10   Before the verification or authentication process can
be used, a formal enrolment process is undergone. In this
enrolment process, the user is requested to give a single
fingerprint in the same fashion as for a normal or bid use.
This is particularly attractive to the user since it
15   minimises the time involved in enrolling but it has to be
recognised that the enrolled image is significantly
imperfect for approximately 20% of the user population.
The present invention overcomes this problem by monitoring
the performance of each user.

20   During a normal use, the user presents his finger to
enable bid biometric data to be determined (step 1). This
determination is performed in a conventional manner to
generate a value or set of values which are then compared
(step 2) with a corresponding reference set which initially
25   has been obtained during the enrolment process. This
comparison may involve determing the difference between two
single values or, in the case of sets of values, dermining
the Euclidean distance between the sets. In another
approach, the reference data can be used to set a tolerance
30   band around the or each reference value and it is
determined whether the corresponding bid values each fall
within their respective tolerance bands.

Whether or not the comparison is successful, an
unsuccessful bid count N is reviewed. This value N
35   represents the number of unsuccessful bids in the last
eight attempts. Thus, the last eight attempts including
the most recent are reviewed and the count N adjusted to

SUBSTITUTE SHEET

6

indicate the number of unsuccessful attempts in those last
eight (step 3).

If the latest bid is unsuccessful, for example
because one or more of the bid values falls outside
5   corresponding tolerance bands or the difference between the
bid and reference data exceeds a predetermined threshold
then the verification or authentication process may end
although in some cases processing may return to step 1 to
allow a further attempt to be processed. A limit may be
10   set on the number of repeats permitted in a certain time
interval.

If the bid is successful then verification will be
indicated (step 4) allowing the user to perform the secure
process to which he has gained access.

15   In addition, in the case of a successful bid, the
count N is reviewed to see whether it is equal to or
exceeds 3. If it is less than 3 then the process ends but
if it is equal to or greater than 3 then the tolerance
reference data is replaced with the most recently obtained
20   bid data (step 5).

In certain circumstances, a user's performance may be
so poor that this process will not be sufficient by itself
to improve the performance. This may be detected if for
example there are four or more consecutive unsuccessful
25   bids or the reference data is replaced three or more times
within a history of 32 attempts. In these cases, the user
can be recommended to reenrol under supervision using a
different finger. The recommendation contains the form of
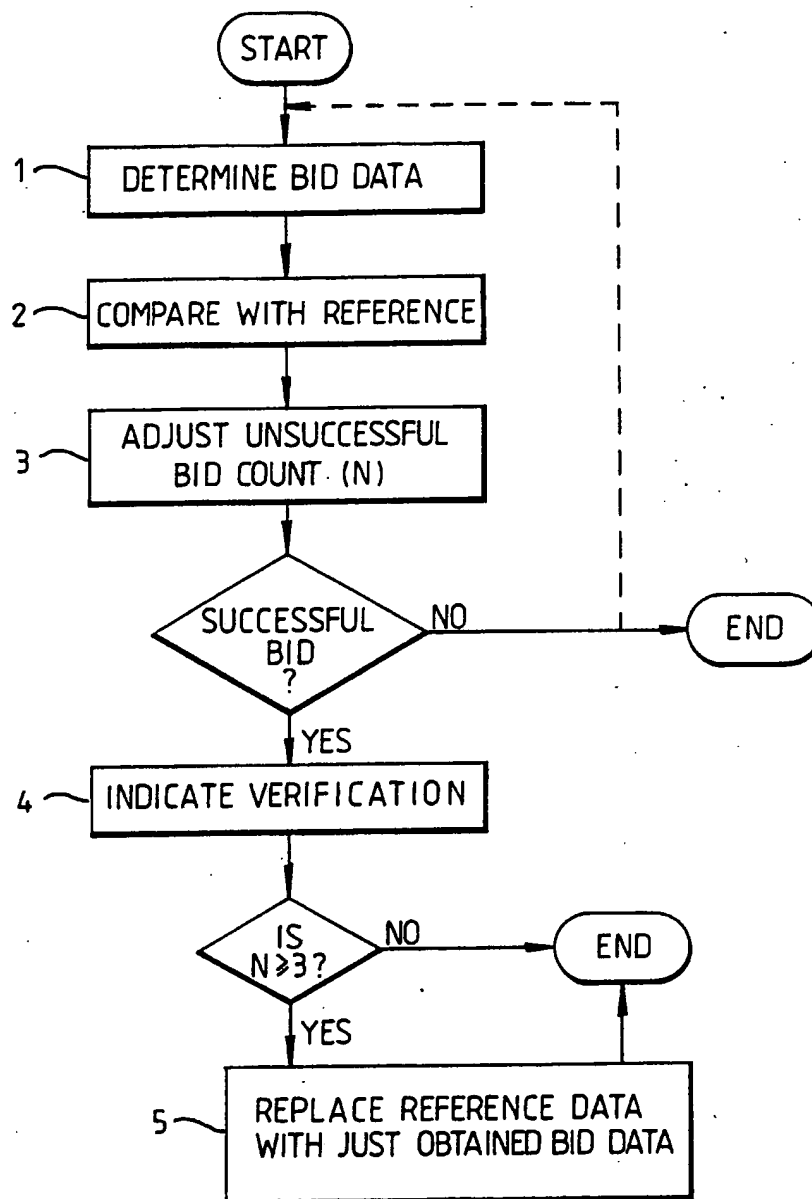an audible or visual warning, repeated at every bid.

SUBSTITUTE SHEET

CLAIMS

1.   A method of updating reference biometric data
characteristic of an individual for use in a verification
or authentication process in which process the relationship
5   between the currently measured biometric data and the
reference biometic data is determined, the method
comprising monitoring the acceptibility of the relationship
determined during a number of verification or
authentication processes; and if a number N of the
10   relationships over a number M of verification or
authentication processes is unacceptable, updating the
reference biometric data with more recently obtained
biometric data.

2.   A method according to claim 1, wherein the more
15   recently obtained biometric data which is used to update
the reference biometric data is selected from biometric
data which satisfies predetermined conditions defining a
better degree of acceptability than is essential to pass
the verification or authentication process.

20   3.   A method according to claim 2, wherein the most
recently obtained measured biometric data which satisfies
the predetermined conditions will be used to update the
reference biometric data.

4.   A method according to any of the preceeding claims,
25   wherein N is at least 3 and M is 8.

5.   A method according to any of the preceeding claims,
further comprising monitoring the performance of the user
and providing an indication that reenrolment is advisable
if the performance of the updating method satisfies
30   predetermined conditions.

6.   A method according to claim 5, wherein the
predetermined conditions comprise the detection of at least
P consecutive unacceptable relationships, or the
performance of at least Q updating steps within R
35   performances of the verification or authentication process.

7.   A method according to claim 6, wherein P is 4, Q is 3
and R is 32.

8

8.   A method according to any of the preceeding claims,
wherein the biometric data define a fingerprint.

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5   G07C9/00 ;   G06K9/20

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G07C ; A61B ; G06K ; G07D

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category°	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 21, no. 1, June 1978, NEW YORK US pages 424 - 425; ANTHONY e.a.: "Supervised adaption for signature verification system" see the whole document	1-3
A	US,A,4451929 (YOSHIDA) 29 May 1984 see column 1, line 41 - column 3, line 21 see column 4, lines 17 - 55; figures	1-3
A	US,A,4724542 (WILLIFORD) 09 February 1988 see abstract; claims 1-8; figures	1-3
A	GB,A,2087548 (OMRON TATEISI) 26 May 1982 see abstract; claims 1-9; figures	1

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the International filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the International filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28 FEBRUARY 1991	19. 03. 91

International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	MEYL D.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US,A,4696046 (SCHILLER) 22 September 1987 see column 3, line 10 - column 4, line 3; figures ---	1
A	EP,A,0075728 (SIEMENS) 06 April 1983 ---	
A	DE,A,2840716 (SIEMENS) 27 March 1980 ---	
A	EP,A,0043988 (PALMGUARD) 20 January 1982 ---	

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 90/01830

SA · 42255

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.   28/02/91

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4451929	29-05-84	JP-A,B,C55066068 DE-A,C 2945377 FR-A,B 2443103 GB-A,B 2035645	19-05-80 22-05-80 27-06-80 18-06-80
US-A-4724542	09-02-88	JP-A- 62177680	04-08-87
GB-A-2087548	26-05-82	JP-A- 57069480 DE-A- 3141017 GB-A,B 2140916 US-A- 4461028	28-04-82 09-06-82 05-12-84 17-07-84
US-A-4696046	22-09-87	EP-A- 0216902 WO-A- 8605903	08-04-87 09-10-86
EP-A-0075728	06-04-83	DE-A- 3138710	21-04-83
DE-A-2840716	27-03-80	None	
EP-A-0043988	20-01-82	US-A- 4371865 CA-A- 1167166 JP-A- 57052972 US-A- 4468807	01-02-83 08-05-84 29-03-82 28-08-84